PATENT ABSTRACTS OF JAPAN

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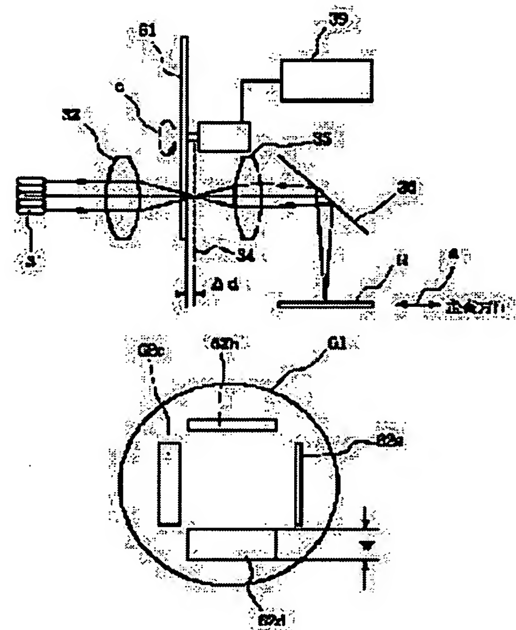
(54) **PROJECTION ALIGNER**

(57)Abstract:
PROBLEM TO BE SOLVED: To realize setting or selection of optimum exposure performance, corresponding to a product to be manufactured by making an illumination optical system have illumination region varying means for varying the width of an illumination region in a first direction, with respect to an illumination region on a mask.
SOLUTION: To change the illumination width (slit width), a slit plate 61 on which a plurality of slits, having different widths are formed, provided on a turret. The slit plate 61 is rotated within a plane perpendicular to the illumination optical axis by a driving section 39. On the slit plate 61, a plurality of slits 62a to 62d having different widths are formed. When the widths of the slits are changed, the exposure performance changes. Thus, a semiconductor device of a high integration degree may be manufactured at a low cost.



LEGAL STATUS

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CLAIMS

[Claim(s)]
[Claim 1] A projection aligner characterized by providing the following The light source which generates illumination light An illumination-light study system which illuminates a predetermined field by the flux of light from the light source Projection optics which projects a pattern on a mask on a sensitization substrate It is the lighting field adjustable means which makes adjustable width of face of said lighting field concerning [on a projection aligner which has a scan means to synchronize said mask and said sensitization substrate and to scan in the 1st direction, and forms a pattern image on said mask on said sensitization substrate serially, and / said illumination-light study system] said 1st direction about a lighting field on said mask.
[Claim 2] said lighting field adjustable means -- said mask in said illumination-light study system near said mask side -- optical -- parenchyma -- a projection aligner according to claim 1 characterized by adjusting a location about said 1st direction of a gobo arranged in a location which only a predetermined distance separated from a location [****] or its conjugation location in the direction of an optical axis.
[Claim 3] one out of two or more drawing which has width of face from which said lighting field adjustable means differs about said 1st direction -- choosing -- said mask in said illumination-light study system near said mask side -- optical -- parenchyma -- a projection aligner according to claim 1 characterized by arranging in a location which only a predetermined distance separated from a location [****] or its conjugation location in the direction of an optical axis .
[Claim 4] It is the projection aligner according to claim 3 characterized by for said two or more drawing being the rectangle slits formed in a disc-like gobo at this gobo and this heart, and said lighting field adjustable means arranging drawing chosen by rotating this gobo from the conjugation location to said conjugation location or predetermined distance detached building ******.
[Claim 5] A semiconductor device characterized by being manufactured using a projection aligner according to claim 1 to 4.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the aligner used in order to expose a layout pattern to the resist on a substrate and to manufacture a semiconductor device etc.
[0002]
[Description of the Prior Art] In the aligner of an one-shot exposure method, when projection optics is constituted by the lens, an image formation field serves as a circle configuration. However, since a semiconductor integrated circuit is generally a rectangle configuration, the imprint field in the case of one-shot exposure turns into a field of the rectangle inscribed in the image formation field of the circle which projection optics has. Therefore, it is the square of the side of 1/root2 of a diameter of circle also in the biggest imprint field. On the other hand, the scan exposure method (a step and scanning method) to which an imprint field is made to expand is proposed by carrying out scan migration using the exposure field of the slit configuration which has the size of a diameter mostly of the image formation field of the circle configuration which projection optics has, synchronizing a reticle and a wafer. By this method, when the projection optics which has the image formation field of the same magnitude is used, a bigger imprint field can be secured compared with the step-and-repeat method which performs one-shot exposure for every imprint field using a projection lens. Namely, since the limit by optical system is lost to a scanning direction, it can secure a stroked part of a scan stage, and a twice [root2] as many imprint field as this can be secured in general in the right-angled direction to a scanning direction.
[0003] Since the aligner for manufacturing a semiconductor integrated circuit corresponds to manufacture of the chip of a high degree of integration, expansion of an imprint field and improvement in resolution are desired. It is advantageous also from optical-character ability that smaller projection optics is employable also in cost, and the exposure method of a step and a scanning method attracts attention as a future aligner being in use.
[0004]
[Problem(s) to be Solved by the Invention] It was the phase examined variously so that this invention persons might raise such a step and the exposure engine performance of the aligner (scan aligner) of a scanning method, and it found out that the width of face of a slit-like lighting field (exposure field) affects the exposure engine performance, however that slit width differed by which exposure engine performance a throughput thinks as important as it falls although distortion becomes good if slit width is made large, for example, and this invention was reached.
[0005] That is, the purpose of this invention is to offer the aligner which can set up or choose the optimal exposure engine performance according to the product which it is going to manufacture.
[0006]
[Means for Solving the Problem] The light source which generates illumination light in this invention in order to attain the above-mentioned purpose, An illumination-light study system which illuminates a predetermined field by the flux of light from the light source, and projection optics which projects a pattern on a mask on a sensitization substrate, In a projection aligner which has a scan means to synchronize said mask and said sensitization substrate and to scan in the 1st direction, and forms a pattern image on said mask on said sensitization substrate serially Said illumination-light study system is characterized by having a lighting field adjustable means which makes adjustable width of face of said lighting field about said 1st direction about a lighting field on said mask.
[0007] a gestalt of desirable operation of this invention -- setting -- said lighting field adjustable means -- said mask in said illumination-light study system near said mask side -- optical -- parenchyma -- it is characterized by adjusting a location about said 1st direction of a gobo arranged in a location which only a predetermined distance separated from a location [****] or its conjugation location in the direction of an optical axis . one [or] out of two or more drawing which has width of face from which said lighting field adjustable means differs about said 1st direction -- choosing -- said mask in said illumination-light study system near said mask side -- optical -- parenchyma -- it is characterized by arranging in a location which only a predetermined distance separated from a location [****] or its conjugation location in the direction of an optical axis. In this case, said two or more drawing is the rectangle slits formed in a disc-like gobo at this gobo and this heart, and said lighting field adjustable means is characterized by arranging drawing chosen by rotating this gobo from that conjugation location to said conjugation location or predetermined distance detached building ******.
[0008]
[Function and Effect] According to this invention, in the projection aligner of a scan mold, in order to be able to carry out adjustable [of the width of face of the lighting field of a scanning direction] according to the purpose, it can respond to a product, and the exposure property optimal as the projection equipment can be set up or chosen. For example, in throughput priority, a lighting field is narrowed and, in precision priority, it extends it.
[0009]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained using a drawing. Drawing 1 is drawing showing typically signs that the aligner concerning one gestalt of operation of this invention was seen from the side, and drawing 2 is the perspective diagram showing the appearance of the aligner. As shown in these drawings, this aligner projects some patterns of the original edition on a reticle stage 1 on the wafer on the wafer stage 3 through projection optics 2. While exposing the pattern of a reticle to a wafer by carrying out the synchronous scan of a reticle and the wafer in the direction of Y relatively to projection optics 2 It is the aligner of step - performed while making the step migration for performing this scan exposure to two or more fields on a

wafer (shot) repeatedly intervene, and - scan mold.
[0010] A reticle stage 1 is driven in the direction of Y with a linear motor 4, and drives X stage 3a of the wafer stage 3 in the direction of X with a linear motor 5, and Y stage 3b drives it in the direction of Y with a linear motor 6. The synchronous scan of a reticle and a wafer is performed by making a reticle stage 1 and Y stage 3b drive in the direction of Y at the fixed rate of a velocity ratio (for example, it to be shown in addition for 4:-being 1 and that the sense of "-" is reverse). Moreover, X stage 3a performs step migration in the direction of X.
[0011] The wafer stage 3 is formed on the stage surface plate 7, and the stage surface plate 7 is supported on the floor etc. by three points through three dampers 8. A reticle stage 1 and projection optics 2 are established on the lens-barrel surface plate 9, and the lens-barrel surface plate 9 is supported through three dampers 11 and a stanchion 12 on the base frame 10 laid in the floor etc. Although a damper 8 is vibration deadening or an active damper which carries out vibration removal actively to 6 shaft orientations, you may support without using a passive damper or minding a damper.
[0012] Moreover, this aligner is equipped with range measurement means 13 to measure the distance between the lens-barrel surface plate 9 and the stage surface plate 7 in three points, such as a laser interferometer and a micro encoder.
[0013] The floodlighting means 21 and the light-receiving means 22 constitute the focal sensor for detecting whether the wafer on the wafer stage 3 is located in the focal field of projection optics 2. That is, light is irradiated from across to a wafer with the floodlighting means 21 fixed to the lens-barrel surface plate 9, and the location on the surface of a wafer of the direction of an optical axis of projection optics 2 is detected by detecting the location of the reflected light with the light-receiving means 22.
[0014] In this configuration, after a wafer is carried in on the wafer stage 3 through the conveyance path between two stanchions 12 of equipment anterior part by conveyance means by which it does not illustrate and position doubling is completed, an aligner carries out the exposure imprint of the pattern of a reticle for scan exposure and step migration to the exposure field of the plurality on a wafer with a repeat. While moving a reticle stage 1 and Y stage 3b in the direction (scanning direction) of Y with a predetermined velocity ratio and scanning the pattern on a reticle with slit-like exposure light on the occasion of scan exposure, the pattern on a reticle is exposed to the predetermined exposure field on a wafer by scanning a wafer by the projection image. During scan exposure, the height on the surface of a wafer is measured by said focal sensor, the height and tilt of the wafer stage 3 are controlled by real time based on the measurement value, and focal amendment is performed. If the scan exposure to one exposure field is completed, by driving X stage 3a in the direction of X, and carrying out step migration of the wafer, other exposure fields will be positioned to the starting position of scan exposure, and scan exposure will be performed. In addition, one of scanning directions positive [of arrangement of each exposure field and Y] or negative, the order of exposure to each exposure field, etc. are set up so that it can expose efficiently one by one to two or more exposure fields on a wafer with the combination of step migration in this direction of X, and the migration for the scan exposure to the direction of Y.
[0015] In the equipment of drawing 1 , the light emitted from the laser interferometer light source which is not illustrated is introduced into the direction laser interferometer 24 for reticle stages of Y. And the light introduced into the direction laser interferometer 24 of Y is divided into the light which faces to the fixed mirror in a laser interferometer 24 (un-illustrating) by the beam splitter in a laser interferometer 24 (un-illustrating), and the light which faces to Y directional movement mirror 26. Incidence of the light which faces to Y directional movement mirror 26 is carried out to Y directional movement mirror 26 fixed to the reticle stage 4 through the direction length measurement optical path 25 of Y. The light reflected here piles up with the light again reflected in the beam splitter in a laser interferometer 2 in return and a fixed mirror through the direction length measurement optical path 25 of Y. The migration length of the direction of Y is measured by detecting change of interference of the light at this time. Thus, the measured migration length information is fed back to the scan control unit which is not illustrated, and the point-to-point control of the scan location of a reticle stage 4 is made. Based on the length measurement result according [Y stage 3b] to the direction laser interferometer 23 for wafer stages of Y similarly, the point-to-point control of a scan location is made.
[0016] Drawing 3 shows the example of 1 configuration of the illumination-light study system in the equipment of drawing 1 . In drawing 1 , 31 is the eye lens of a fly, and incidence of the flux of light from the non-illustrated source of the illumination light which consists of an assembly of two or more minute lenses, and consists of excimer laser etc. is carried out, and it forms two or more secondary light sources near the irradiation labor attendant. The condensing optical system to which 32 condenses the flux of light from the eye lens 31 of a fly, the movable slit as which 33a and 33b determine the width of face of lighting, and 35 are image formation lenses which project the condensing field 34 on Reticle R through a mirror 36. Reticle R is scanned by the scanning direction shown by the arrow head a. The condensing field 34 is in physical relationship [****] optically with Reticle R, and the movable slits 33a and 33b are put on the location from which only predetermined distance deltad was separated in the direction of an optical axis from the condensing field 34. Thus, it is considering as trapezoid distribution as shows quantity of light distribution of the scanning direction of the lighting-on reticle R field determined by the movable slits 33a and 33b to drawing 4 by shifting the movable slits 33a and 33b from the condensing field 34. 39 is a drive system which makes slit width adjustable, and by driving in the direction which shows the movable slits 33a and 33b by the arrow head b perpendicular to a scanning direction and illumination-light shaft orientations, slit width (width of face of the scanning direction of a lighting-on reticle R field) can be narrowed or extended, and as shown in the continuous line 41 and dashed line 42 of drawing 4 , it can carry out adjustable [of said quantity of light distribution].
[0017] In addition, the above-mentioned deltad is also to 0 - That is, the movable slits 33a and 33b can also be put [also placing on the condensing field 34, and] on the side near [field / 34 / condensing] the image formation lens 35. However, when the movable slits 33a and 33b are placed on the condensing field 34, quantity of light distribution of said scanning direction becomes rectangle-like.
[0018] Drawing 5 shows other examples of a configuration of the illumination-light study system in the equipment of drawing 1 . The movable slits 33a and 33b are arranged near the reticle R.
[0019] Drawing 6 shows the example of a configuration of further others of the illumination-light study system in the equipment of drawing 1 . In order to change lighting width of face (slit width), it arranges on the turret whose slit board 61 in which the slit which has the width of face from which plurality differs was formed is not illustrated, and the slit board 61 is rotated in a field perpendicular to an illumination-light shaft by the mechanical component 39, as shown in an arrow head c. As shown in the slit board 61 at drawing 7 , two or more slits 62a-62d which have different width of face w are formed.
[0020] In the scan mold aligner of drawing 1 , modification of the width of face of a slit changes an exposure property. For example, a throughput falls, in order that only the part may extend the scan distance of a reticle stage and a wafer stage, if slit width becomes large.
[0021] A table 1 shows the relation of the slit width and each exposure property which this invention persons examined.

[0022]
[A table 1]

露光特性	スリット幅	
	小	大
スループット	○	△
ディストーション	△	○
Ｄｏｓｅ精度	×	○
スペックル（エキシマの場合）	×	○
ランニングコスト（パルス数）	○	△
ＣＤ均一性	△	○

○：有利

△：性能が劣る

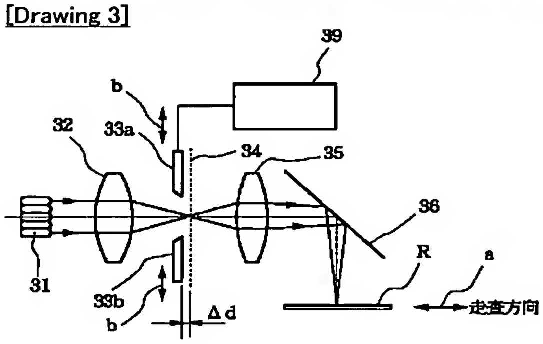
×：悪い

[0023] Therefore, it can expose by choosing or setting up the optimal exposure property by referring to a table 1 and setting up slit width suitably within limits allowed in the aligner. For example, what is necessary is to narrow slit width, when it gives priority to a throughput or a running cost, and just to extend slit width, when it gives priority to precision.
[0024] Example drawing 8 of manufacture of a minute device shows the flow of manufacture of minute devices (semiconductor chips, such as IC and LSI, a liquid crystal panel, CCD, the thin film magnetic head, micro machine, etc.). The circuit design of a semiconductor device is performed at step 1 (circuit design). The mask in which the designed circuit pattern was formed is manufactured at step 2 (mask manufacture). On the other hand, at step 3 (wafer manufacture), a wafer is manufactured using materials, such as silicon. Step 4 (wafer process) is called a before production process, and forms an actual circuit on a wafer with lithography technology using the mask and wafer which carried out [above-mentioned] preparation. The following step 5 (assembly) is called an after production process, is a production process semiconductor-chip-ized using the wafer produced by step 4, and includes production processes, such as an assembly production process (dicing, bonding) and a packaging production process (chip enclosure). At step 6 (inspection), the check test of the semiconductor device produced at step 5 of operation, an endurance test, etc. are inspected. A semiconductor device is completed through such a production process, and this is shipped (step 7).
[0025] Drawing 9 shows the detailed flow of the above-mentioned wafer process. The surface of a wafer is oxidized at step 11 (oxidation). An insulator layer is formed in the wafer surface at step 12 (CVD). At step 13 (electrode formation), an electrode is formed by vacuum evaporationo on a wafer. Ion is driven into a wafer at step 14 (ion implantation). A sensitization agent is applied to a wafer at step 15 (resist processing). At step 16 (exposure), printing exposure of the circuit pattern of a mask is carried out at a wafer with the aligner which gave [above-mentioned] explanation. The exposed wafer is developed at step 17 (development). At step 18 (etching), portions other than the developed resist image are shaved off. The resist which etching could be managed with step 19 (resist exfoliation), and became unnecessary is removed. By carrying out by repeating these steps, a circuit pattern is formed on a wafer multiplex.
[0026] If the manufacture method of this example is used, the semiconductor device of the high degree of integration for which manufacture was difficult can be conventionally manufactured to low cost.

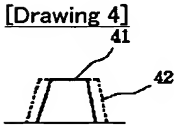
[Translation done.]

DRAWINGS

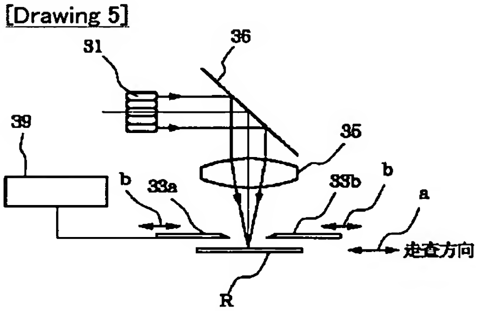
[Drawing 3]



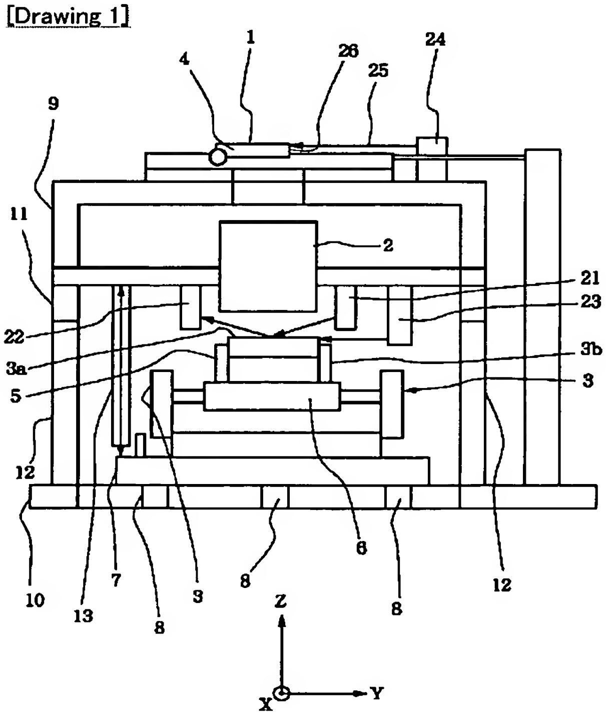
[Drawing 4]



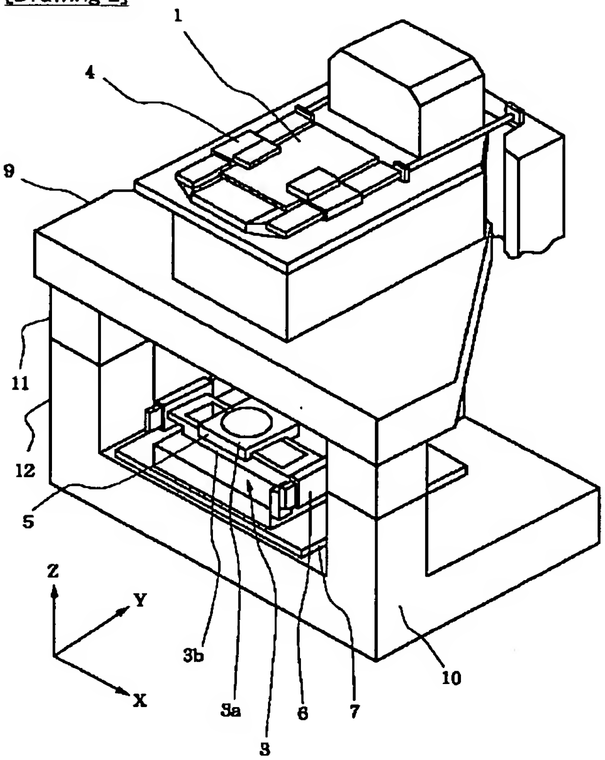
[Drawing 5]



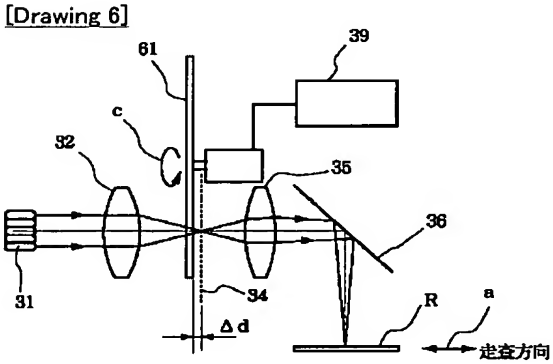
[Drawing 1]



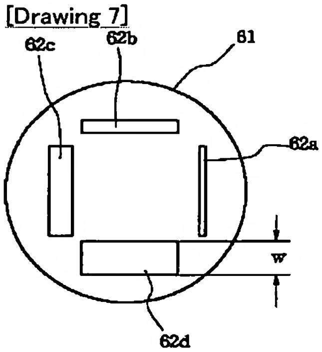
[Drawing 2]



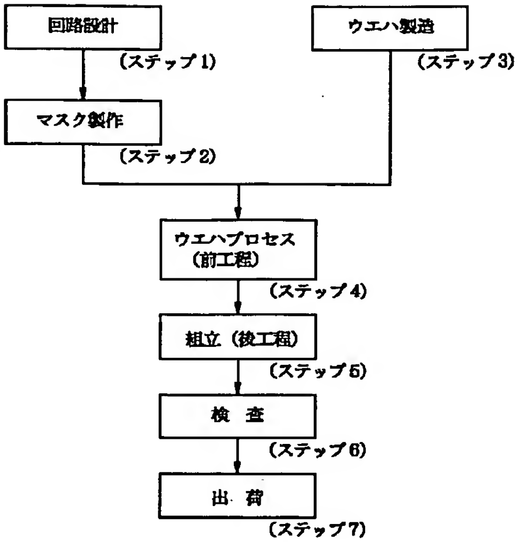
[Drawing 6]



[Drawing 7]

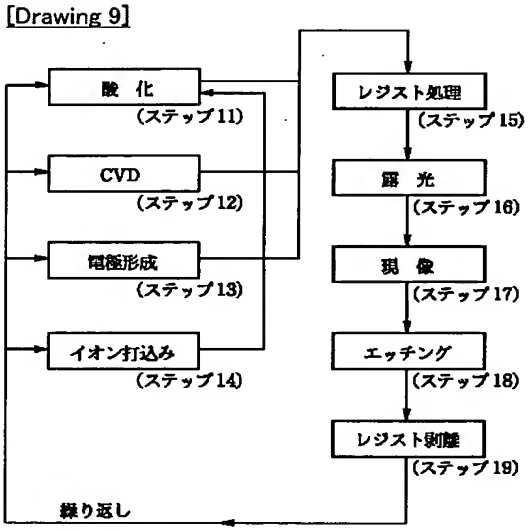


[Drawing 8]



半導体デバイス製造フロー

[Drawing 9]



ウエハプロセス

[Translation done.]